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ORIGINAL ARTICLE

Evaluation of Renal Function and Plasma Osmolality among Covid-19 Patients in Sudan

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ABSTRACT

Objective: COVID-19 is a very serious disease and is considered a pandemic by the WHO. The aim of this study is to determine the renal function and serum osmolality among COVID-19 patients in Khartoum state, Sudan.

Method: This is retrospective study was conducted in Gebra Hospital, Khartoum state, Sudan from April 2021 to August 2021. The study enrolled 50 patients with Covid-19 and 50 healthy individuals as a control group. After all the enrolled participants signed the informed consent the samples were analyzed for Creatinine, Urea, Sodium, and potassium. By using an A25 fully automated chemistry analyzer, and serum Osmolality (mOsm / kg) was calculated according to Smithline and Gardner formula.

Results: The study revealed a significant increase of the mean of Urea (P.value = 0.001), Creatinine (P.value = 0.001), however significant decrease in the mean of e GFR (P.value<0.05) on the first day of the admission. There was a significant increase in the mean of plasma Urea, Creatinine, and eGFR on the 7th day of admission when compared with the first day, P.value = (0.0001), (0.001), (0.001), respectively. The study revealed a significant difference in plasma Osmolality in COVID-19 patients (280.73 ±16.10 mOsm/kg) when compared with the control group (288.13 ±3.42 mOsm/kg), P.value = 0.0.

Conclusion: COVID-19 does not affect only the lungs; it can also affect the kidney. This study concluded that there were an elevated serum creatinine, blood urea, and low glomerular filtration, and there was a significant difference in serum osmolality in COVID- 19 than in the healthy group.

Keywords: COVID -19; Serum Osmolality; eGFR; Renal function; Sudan.

INTRODUCTION

Coronavirus disease or (COVID-19 (SARS COV-2) is a very series disease .It has been categorized as a public health emergency by the WHO. This infectious disease rapidly spread from Wuhan, China to other Chinese regions [1- 3]. Since March 2020, Coronavirus cases have been detected in most countries universally, on March 2020, COVID-19 was considered as a pandemic by the WHO [4,5]. Roughly 81% of the patients are mild cases. Conversely, 5% of critically ill cases improved rapidly to acute respiratory distress syndrome and acute respiratory failure. The total mortality rate is 2.3%, whereas among critical cases the crude mortality rate reaches 49% [6, 7]. The most common symptoms are mild acute respiratory infection symptoms, for example, dry cough, fever, and fatigue, these symptoms usually occur in the early stages of the disease. Conversely, some patients develop acute respiratory distress syndrome rapidly; acute respiratory failure, multiple organ failure, and other fatal complications [8, 9]. The symptoms of COVID-19 are more common in elderly people and those with chronic diseases than young normal people [10-13]. Recent studies reported that the rate of COVID-19 with organ dysfunction is about 33%, and involve several organ defects, such as myocardial injury, lymphocyte reduction, liver dysfunction, and acute kidney injury (AKI) which forms about 3-7%, besides that more than 20% of death cases were affected by chronic kidney disease (CKD) [14-21]. The kidney expresses a highly Angiotensin-converting enzyme-2 (ACE2), and that may clarify the presenting common kidney association with COVID-19 cases [22]. As it is known the critical role of the kidney in the regulation and maintenance of blood pressure and electrolyte balance, so the impairment of renal function can lead to obstruction of excretion of metabolites and toxins in the body, which will unpleasantly affect the conservation of the electrolyte and acid-base balance process of the body. Moreover, when renal function is affected, uremia will take place, and threaten life. Therefore the early intervention and finding of any indication of renal injury are of great value to reduce the complications and eliminate the bad prognosis of the disease for these reasons, the kidney's function in COVID-19 is essential to be assessed. Unfortunately, insufficient studies are conducted particularly in Sudan to reveal the role of increased incidence of the renal defect following COVID-19 infection. Hence this study aims to evaluate some laboratory investigations, including serum Creatinine, Urea, eGFR, Sodium (Na^+), Potassium (K^+) levels, and serum Osmolality among Sudanese patients diagnosed with COVID-19.

MATERIALS AND METHODS

Study Design and Patients: This is a retrospective study conducted in quarantine center, Gebra Hospital, Khartoum state from April 2021 to August 2021. The study population was 50 patients diagnosed with covid-19 and 50 healthy individuals as a control group. The participants are 20-80 years of age. The patients are diagnosed with COVID-19 by Polymerase Chain Reaction (PCR) technique according to the WHO interim guidance. Patients were sub classified according to the severity of disease into mild, moderate, and severe. Then 5ml of venous blood was taken under all septic conditions from each group (case and control) in lithium heparin blood containers. All blood samples are allowed to clot and centrifuged at 4000 rpm to obtain the plasma samples. The samples were stored at (-20 °C) until the assay time of Creatinine, Urea, Sodium, and potassium. By using A25 fully automated chemistry analyzer, Biosystems, C/CostaBrava, 3008030, Barcelona, (Spain). Serum Osmolality was calculated according to Smithline and Gardner formula, which proposed to use: Serum osmolality = 2(Na) + glucose/18 + BUN/1.8 [23]. Glomerular Filtration Rate (eGFR) was calculated by using Cockcroft Gault Formula. GFR (ml/min) = (140-age) × (weight kg) ÷72×Scr (mg/dl) × (0.85 if female).

Inclusion and exclusion criteria: Covid-19 patients; confirmed with PCR test are included in this study. While Patients with hematological malignancies, immunodeficiency, those on renal replacement therapy are excluded from the study.

Ethical issue: The current study was consistent with the ethical guidelines of the 1975 Declaration of Helsinki and was approved by the research ethics committee at the faculty of medical laboratory science, Alzaiem Alazhari University, Khartoum, Sudan. All enrolled participants signed the informed consent; data were collected on their medical history, socio-demographic features included sex, age, comorbidities, and symptoms on admission by using a structured questionnaire.

Statistical analysis: Data were entered and analyzed using a statistical package for social sciences (IBM SPSS-version 20) on a programmed computer. Data were expressed as mean ± S.D, and

percentages and the results were shown in tables, and figures. Chi-square tests were used in the analysis of categorical variables, and for a continuous variable, the t-test was used to compare between the two groups (cases and controls). The Pearson's correlation coefficient (Pearson's r) was used to assess the correlation between different variables. A p-value of ≤ 0.05 is considered significant.

RESULT

In the current study the 50 covid-19 patients are classified into mild (n=18), moderate (n=19) and severe (n=13) according to disease severity as shown in (Table.1). The majority of cases were males (52%) who demonstrated that the incidence of COVID-19 is higher in males than females on the first day of admission as shown in (Table.1). The study revealed a significant increase of the mean of Urea (P.value = 0.001), Creatinine (P.value = 0.001), however significant decrease in the mean of e GFR (P.value<0.05) when compared with normal reference value on the first day of the admission as in (Table.2). The study showed a significant increase in the mean of plasma urea, creatinine, and eGFR on the 7th day of admission when compared with the first day of admission P.value = (0.0001), (0.001), (0.001), respectively (Table.2).There were significant positive correlation of plasma urea, creatinine when compare with disease severity (P.value =0.000, and 0.000) (Figures: 1, 2), respectively and(R= 0.859, and 0 .785), respectively. Conversely there is a significant negative correlation between e GFR and disease severity (P.value = 0.000 R= -803) (Table.2, Figure.3). The current study revealed a significant difference in plasma Osmolality in COVID-19 patients (280.73 ±16.10 mOsm/kg) when compared with the control group (288.13 ±3.42 mOsm/kg), P.value = 0.0, and also showed a negative significant correlation of osmolality to eGFR of COVID 19 patients as in (Figure.4).

Table 1: Gender and disease stages in the COVID 19 patients the frequency

		Frequency	Percent (%)
Gender	Male	26	52.0
	Female	24	48.0
Severity	Mild	18	36.0
	Moderate	19	38.0
	Severe	13	26.0

Table 2: Comparison of plasma urea creatinine and eGFR in COVID 19 patients between two times of admission by paired test

		Mean	Std. Devayion	P. Value
Urea mg\dl	1st day admission	41.56	15.470	0.0001
	7th day admission	59.5800	32.34640	
Creatinine mg\dl	1st day admission	1.118	.4543	0.0001
	7th day admission	1.6548	1.02230	
eGFR(ml)	1st day admission	83.32	22.536	0.0001
	7th day admission	62.5200	29.17942	

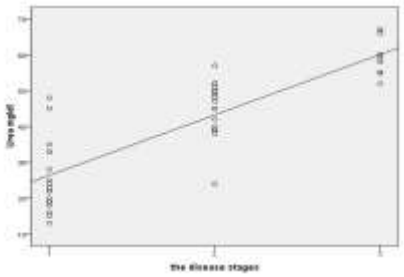

Figure 1: Correlation of the disease stage to the blood urea level, R= 0.85, P.value = 0.000

1≡ mild disease stage on x axis, 2 ≡ moderate disease stage and 3 ≡ severe disease stage

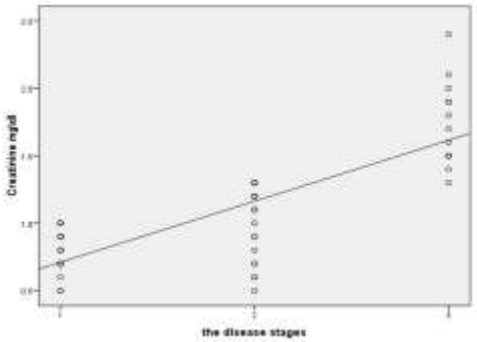

Figure 2: Correlation of the disease stage to the blood creatinine level, R= 0.78, P.value = 0.000

1≡ mild disease stage on x axis, 2 ≡ moderate disease stage and 3 ≡ severe disease stage

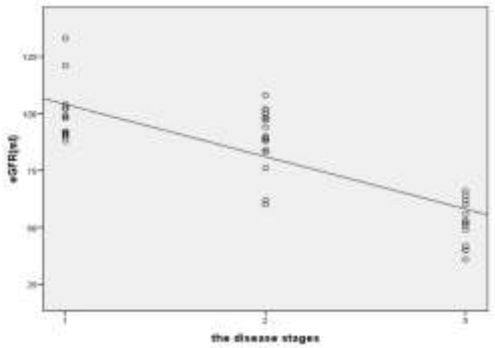

Figure 3: Correlation of the disease stage to the eGFR, R= - 0. 803, P.value = 0.000

1≡ mild disease stage on x axis, 2 ≡ moderate disease stage and 3 ≡ severe disease stage

DISCUSSION

Coronavirus COVID-19 broke out in Wuhan in December 2019 and has posed a big threat to public health. The records of new cases and deaths are increasing quickly worldwide. Although COVID-19 affects mainly the lungs it can also impact the kidney comprehensively. However, the clinical characteristics of renal dysfunction caused by SARS-CoV-2 are rarely described. So to the best of our knowledge, this is one of the few studies in Sudan focused on the COVID-19 and it is influence on renal functions. This study includes 50 adult patients (20-80 years) who were sub-classified into mild, moderate, and severe according to disease severity after they were hospitalized with COVID-19 in the isolation center. The median age of the patients was 72 years, and this goes with a previous study performed by Kang Yang Yang, Liu, et al, and Yang, Sunren et al [24, 25]. Also, the results had shown that the gender frequencies of COVID -19 patients in males more than females, and this result were matched with the study of Arikan H, Ozturk S et al [26]. This revealed that acute kidney disease (AKI) is associated with extremely high mortality among hospitalized COVID-19 patients. This study revealed a significant increase of the mean of Urea (P.value = 0.001), Creatinine (P.value = 0.001), however significant decrease in the mean of e GFR (P.value<0.05) when compared with normal reference value on the first day of the admission. The study showed a significant increase in the mean of plasma urea, creatinine, and eGFR on the 7th day of admission when compared with the first day of

admission P.value = (0.0001), (0.001), (0.001), respectively and these results agree with the previous study done by (Liu Y, Qi FY, and Cheng Y, Luo R, et al [27,28], which found that patient showed an increase of urea, creatinine levels in the 7th day after admission .this study exhibited that there was a significant positive correlation of plasma urea, creatinine when compare with disease severity (P.value =0.000, and 0.000), respectively and(R= 0.859, and 0 .785), respectively. Conversely, there is a significant negative correlation between e GFR and disease severity (P.value = 0.000 R= -803), these results showed an agreement with the study done by (Nogueira SÁR et al [29]. The current study revealed a significant difference in plasma Osmolality in COVID-19 patients (280.73 ±16.10 mOsm/kg) when compared with the control group (288.13 ±3.42 mOsm/kg), P.value = 0.0, and also showed a negative significant correlation of osmolality to eGFR of COVID 19 patients, and this result agrees with the study of Ramesh J, et al [30].This research is a hospital-based study and the participants do not represent all the patients. So this study has some limitations such as the small sample size, all the patients in this study were from Khartoum, so it will be better to do more studies including a wide geographic region of Sudan

CONCLUSION

COVID-19 is a disease not only affecting the lungs; it can also affect the kidneys. This study concluded that there were elevations in the levels of serum creatinine, blood urea, and estimated glomerular filtration under 60 ml\min. This study confirmed that there is a significant difference in serum osmolality in COVID- 19 patients than in the control group and a significant positive correlation between the serum osmolality and disease severity. For elderly patients mainly over 72 years of age, attention must be taken in case of treatment, and drug use to maintain electrolyte and acid-base balance and prevent renal defects.

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Conflict of interest: The authors declare that they have no competing interests.

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